STP Nuclear Operating Company
South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

July 18, 2007
NOC-AE-07002186
10CFR50.90

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Response to Request for Additional Information on
Proposed Amendment for Alternate Radiological Source Term (AST) Methodology;
TAC Nos. MD 4996 & MD 4997

References: 1. Letter from David W. Rencurrel to NRC Document Control Desk dated March 22, 2007, "Request for License Amendment Related to Application of the Alternate Source Term" (NOC-AE-07002127)
2. Letter from Charles T. Bowman to NRC Document Control Desk dated April 10, 2007, "STPNOC Alternate Source Term License Amendment Application" (NOC-AE-07002147)

In Reference 1, the STP Nuclear Operating Company (STPNOC) submitted a license amendment request to support application of an alternate source term (AST) methodology. In Reference 2, supplementary information was provided to support the AST application. Reference 2 included the Containment Sump post-LOCA pH calculation. This submittal responds to NRC questions regarding this calculation.

There are no commitments in this submittal. If you have any questions, please call Ken Taplett at 361-972-8416 or me at 361-972-7867.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 7/18/07.
Date

David W. Rencurrel
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Attachment: STPNOC Response to Request for Additional Information

A001

STI: 32183919

NRR

cc:
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STPNOC RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

REQUEST FOR ADDITIONAL INFORMATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION PROPOSED LICENSE AMENDMENT FOR ALTERNATE RADIOLOGICAL SOURCE TERM (AST) METHODOLOGY SOUTH TEXAS PROJECT UNITS 1 AND 2 DOCKET NUMBERS 50-498 AND 50-499

The licensee determined the post-LOCA containment sump water pH using the STARpH computer code. Since the U.S. Nuclear Regulatory Commission staff did not have an opportunity to review this code, the information needed for performing the evaluation of the licensee's program has to be obtained from the description in the submittal, supplemented by the following request for additional information (RAI) prepared by the staff.

<u>NRC RAI #1</u>

In the methodology for determining the post LOCA suppression pool water pH, the licensee employed a two step procedure. In the first step no buffering action of trisodium phosphate (TSP) is assumed. Without the buffer the pH of the suppression pool water will monotonically decrease and eventually will drop below a value of 7. In the second step, the licensee calculated the value of pH at 30 days after a LOCA including buffering action of TSP. When this pH value at 30 days after a LOCA is equal to or higher than 7, because of its monotonic decrease as a function time, all of the pH values for time shorter than 30 days must also be higher than 7. However, this method does not allow calculation of the actual pH values at different time intervals between zero and 30 days after a LOCA.

Describe how the values of pH listed in Table 4.3-3 were calculated.

STPNOC Response

The transient pH was calculated according to the integrated MeV for each of the following time intervals (the end-time for each interval is given):

End-time for each interval (hours)	MeV absorbed by water over interval	MeV (gamma) available for absorption by Hypalon-bearing material over interval	MeV (beta) available for absorption by Hypalon-bearing material over interval	MeV (total) available for absorption by Hypalon-bearing material over interval
1	1.72E+23	2.26E+22	2.42E+22	4.68E+22
2	6.50E+22	1.48E+22	1.49E+22	2.97E+22
5	1.35E+23	3.09E+22	3.03E+22	6.13E+22
12	2.21E+23	4.19E+22	4.37E+22	8.56E+22
24	2.93E+23	4.44E+22	5.28E+22	9.72E+22
72	8.25E+23	1.18E+23	1.50E+23	2.67E+23
240	1.52E+24	2.06E+23	2.98E+23	5.05E+23
480	9.61E+23	1.02E+23	1.50E+23	2.52E+23
720	6.18E+23	5.38E+22	5.67E+22	1.11E+23
Total	4.81E+24	6.35E+23	8.21E+23	1.46E+24

The nitric acid production is on the basis of 0.007 molecules per 100 eV absorbed by the water. Noble gas is not considered to be dissolved in the water; however, 90% of the other radionuclides released from the core are assumed to be present from t = 0.

The hydrochloric acid production is based on a normalized R_{gamma} = 3.00E-15 mole-cc/MeV-lbm and a normalized R_{beta} = 1.52E-15 mole-cc/MeV-lbm where the lbm applies to the mass of Hypalon-bearing insulation/jacket material inside containment. A containment free volume of 9.57E+10 cc is used to determine the MeV/cc based on the above values for MeV, and the Hypalon-bearing material mass is 60,132 lbm. Because of the penetrating nature of the gamma radiation, only 5.4% of the available radiation energy is absorbed by the Hypalon-bearing material. Because of the limited range of beta radiation in air (and the shielding provided by cable trays and conduit), only 2.7% of the available beta radiation energy is absorbed by the Hypalon-bearing material. These fractions can be determined from the ratio of the product of the normalized values for R_{gamma} and R_{beta} and the mass of Hypalon-bearing material divided by the containment free volume (i.e., 3.00E-15 x 60,132 /9.57E+10 = 1.885E-21 for gamma and 1.52E-15 x 60,132 /9.57E+10 = 9.55E-22 for beta) to the G value for Hypalon (i.e., 3.512E-20 moles/MeV). In other words, if the available gamma and beta radiation were completely absorbed by the Hypalon-bearing material, the number of moles of HCl generated would be the product of the available radiation energy (gamma + beta) x 3.512E-20 moles per MeV rather than the product of the available radiation energy times (R_x x 60,132 lbm /9.57E+10 cc) where R_x is either the normalized R_{gamma} or the normalized R_{beta} in units of mole-cc/MeV-lbm.

The gamma and beta radiation in the containment atmosphere available for irradiation of cable is assumed to be present at t = 0 and includes the noble gas and 10% of the other radionuclides which are assumed to remain effectively airborne in the containment atmosphere (not added to the sump in spite of the spray operation). Also, 12.5% of the gamma radiation energy generated in the sump water is assumed to escape the sump water and to irradiate cable. This assumption is made in spite of the fact that 100% of that same energy is assumed to produce nitric acid by radiolysis in the sump.

Since the absorbed energy in the sump water and the energy available to irradiate Hypalon-bearing material in the containment atmosphere are both calculated on a time-dependent basis (as presented in the above table), the pH may be calculated at the end of any interval. In this way the time-dependent pH is determined.

NRC RAI #2

Describe how the nitric acid in the post- LOCA containment environment was determined.

STPNOC Response

Refer to the response to RAI #1.

NRC RAI #3

The equation on page 108 of Appendix 1 was developed based on the methodology described in NUREG/CR-5950 and was used in the STARpH code for determining the amount of hydrochloric acid (HCl) generated in the sump water during the 30 day period after a LOCA . However, in their review the staff found that the amount of HCI calculated by this equation is insignificantly small and would not provide enough hydrogen ions to produce the values shown in Table 4.3-3. Justify this discrepancy.

STPNOC Response

Note that the HCl is assumed to be generated by chlorine released from the irradiation of Hypalon-bearing insulation/jacket material due to the exposure of that material to airborne activity and an assumed 12.5% of the gamma energy generated in the sump – it is not assumed to be generated in the sump water as the question implies. Nitric acid is assumed to be generated in the sump water.

As explained in the response to RAI #1, the approach illustrated by the equation identified on page 108 of Appendix 1; i.e.,

$$R = R_{\gamma H} + R_{\beta H}$$

where	R	=	the total rate of HCl generation rate (gm-mols/sec)
	$R_{\gamma H}$	=	the HCl generation rate due to γ radiolysis (gm-mols/sec)
	$R_{\beta H}$	=	the HCl generation rate due to β radiolysis (gm-mols/sec)

is used to determine the HCl generation by Hypalon irradiation. However, the actual numerical values given for $R_{\gamma H}$ and $R_{\beta H}$ on page 108 of Appendix 1 represent the normalized R values (i.e., normalized by EN/V, where E is the available gamma or beta power in MeV/sec, N is the mass of the Hypalon-bearing material in lbm, and V is the containment free volume in cc), not the absolute R values. Therefore, the numerical values were given in the wrong units. The units should have been mole-cc/MeV-lbm. To obtain the absolute R values in units of mole/sec, the normalized values must be multiplied by a constant (60,132 lbm of Hypalon-bearing material inside containment divided by the containment free volume of 9.57E+10 cc) and then by the average available gamma and beta radiation power over each time interval (in units of MeV/sec). This average available gamma and beta radiation power over each time interval may be obtained from the time-integrated (i.e., energy) values given in the table found in the RAI #1 response divided by the duration of each interval in seconds.